

**CLAIMS**

What is claimed is:

- 1     1.     A fluid flow restrictor, for use in a solenoid operated valve, comprised of:  
2             a main body portion, with a longitudinal bore extending therethrough, having a  
3     first longitudinal end and a second longitudinal end;  
4             a head portion, located at said first longitudinal end, peripherally surrounding said  
5     main body portion and having a first end of said longitudinal bore integrated therewithin;  
6             an annular flange located adjacent to said head portion, peripherally surrounding  
7     said main body portion and having a top side and a bottom side;  
8             a gullet having one end located adjacent said flange bottom side and forming an  
9     intermediate piece of said main body portion; and  
10            a guide portion, located adjacent another end of said gullet, having a plurality of  
11     legs radially extending from said main body portion, with an outer diametrical extent  
12     thereof being substantially equal to the outer diameter of said annular flange, said gullet  
13     serving to longitudinally separate said annular flange and said guide portion.
- 1     2.     The restrictor as in claim 1 wherein said annular flange has an outer surface having  
2     a first portion which is parallel with the longitudinal axis of said restrictor and a second  
3     portion having an inwardly angled outer surface starting from said first portion and ending  
4     at said bottom side.
- 1     3.     The restrictor as in claim 2 wherein said second portion has an angle in the range  
2     of 7°-15° relative to said first portion outer surface.

1 4. The restrictor as in claim 2 wherein said second portion has an angle in the range  
2 of 10° -14° relative to said first portion outer surface.

1 5. The restrictor as in claim 2 wherein said second portion has an angle of 12° relative  
2 to said first portion outer surface.

1 6. The restrictor as in claim 1 wherein said head portion has a separate bore for  
2 receiving an orifice body.

1 7. The restrictor as in claim 1 wherein said head portion includes an integral orifice.

1 8. The restrictor as in claim 1 wherein said main body portion, said head portion, said  
2 annular flange and said guide portion are part of a one-piece construction.

1 9. An improved solenoid valve assembly for controlling fluid flow, said assembly  
2 including:

3 a valve body having an inlet and an outlet, a bore defining a main fluid passage in  
4 communication with said inlet and outlet, and a valve seat located on a innermost end of  
5 said bore between said inlet and outlet;

6 a diaphragm assembly, interposed between said valve body and a valve body cover  
7 and located between said inlet and outlet, said diaphragm assembly being engagable with  
8 said valve seat and movable for contacting said seat and closing said main fluid passage, as  
9 well as defining a chamber within said valve body;

10 a passage within the diaphragm assembly for providing fluid communication  
11 between said inlet and said chamber;

12 a pilot passage in the diaphragm assembly for providing fluid communication  
13 between said chamber and said outlet;

14 a movable pad responsive to an external signal for controlling flow through said  
15 pilot passage,

16 wherein the improvement comprises said diaphragm assembly including a generally  
17 symmetrical fluid flow restrictor, moveable within the valve body main fluid passage, said  
18 restrictor having a head portion, an intermediate portion and a guide portion surrounding a  
19 main body portion with said main body portion having the pilot passage extending  
20 therethrough, said head portion having a first end of said pilot passage integrated  
21 therewithin, said intermediate portion including an annular extension with an upper side  
22 and a lower side, said guide portion having a plurality of legs radially extending from said  
23 main body portion for a distance substantially equal to the outer diameter of said annular  
24 extension, with said guide portion being spaced from and interconnected with said  
25 intermediate portion by a reduced diameter gullet portion.

1 10 The improved solenoid valve assembly as in claim 9 wherein said annular extension  
2 is substantially cylindrical.

1 11. The improved solenoid valve assembly as in claim 10 wherein a lower portion of  
2 the outer surface of said substantially cylindrical annular extension is inwardly angled  
3 relative to the cylindrical outer surface.

1 12. The improved solenoid valve assembly as in claim 10 wherein a lower portion of  
2 the outer surface of said substantially cylindrical annular extension includes at least arc  
3 portions having radii smaller than the radius of said substantially cylindrical upper portion.

1 13. The improved solenoid valve assembly as in claim 9 wherein the longitudinal  
2 extent of said gullet portion is equal to or less than the maximum travel distance of said  
3 restrictor minus the longitudinal extent of said annular extension.

1 14. The improved solenoid valve assembly as in claim 9 wherein said head portion  
2 has a central cavity adapted for receiving an orifice body.

1 15. The improved solenoid valve assembly as in claim 9 wherein the radial distal end  
2 portions of said plurality of legs are interconnected via a continuous, circular, annular  
3 peripheral portion.

1 16. The improved solenoid valve assembly as in claim 15 wherein said annular  
2 peripheral portion has an outer diameter substantially equal to the outer diameter of said  
3 annular extension.

1 17 The improved solenoid valve assembly as in claim 16 wherein the outer diameter  
2 of said annular peripheral portion is slightly less than the diameter of said valve body  
3 main fluid passage.

1 18. The improved solenoid valve assembly as in claim 15 wherein said head portion  
2 includes a central cavity adapted for receiving an orifice body.

1 19. The improved solenoid valve assembly as in claim 9 wherein said diaphragm pilot  
2 passage has a diameter greater than the diameter of said diaphragm passage.

1 20. The solenoid valve assembly as in claim 9 wherein said restrictor is of a one-piece  
2 construction.

1 21. A diaphragm assembly for regulating fluid flow within a solenoid valve wherein  
2 said diaphragm assembly is adapted to move within a cavity of a valve body of said  
3 solenoid valve from an at rest position to a fully open position, said valve body having a  
4 valve seat located on an innermost end of said cavity, said diaphragm assembly being  
5 comprised of:

6 a main body portion, with a longitudinal bore extending therethrough, having a  
7 first longitudinal end and a second longitudinal end;

8 a head portion located at said first longitudinal end, peripherally surrounding said  
9 main body portion and having a first end of said longitudinal bore integrated therewithin;

10 a diaphragm located adjacent to and connected with said head portion and adapted  
11 to be moveable from said at rest position, in which said diaphragm is sealingly engaged  
12 atop said valve seat in a fully closed position, to said fully open position, in which said  
13 diaphragm moves longitudinally away from said valve seat;

14 an annular flange located adjacent to said diaphragm, peripherally surrounding said  
15 main body portion and having a top side and a bottom side, and being moveable with said  
16 diaphragm from said closed position, in which said top side is radially aligned with said  
17 valve seat, to said fully open position in which bottom side is axially spaced from said  
18 valve seat;

19 a reduced diameter gullet having one end located adjacent said flange bottom side  
20 and peripherally surrounding said main body portion, said gullet being moveable with said  
21 diaphragm from said closed position, in which said gullet is longitudinally located wholly  
22 within said valve body cavity, to said fully open position, in which said gullet is adjacent  
23 said valve seat; and

24 a guide portion, located adjacent another end of said gullet, having a plurality of  
25 legs radially extending from said main body portion, with an outer diametrical extent  
26 thereof being substantially equal to the outer diameter of said annular flange, said guide

27 portion being positioned wholly within said cavity in both said closed and fully open  
28 positions.

1 22. The diaphragm assembly of claim 21 wherein, except for said diaphragm, the  
2 remainder of said diaphragm assembly components are comprised of a unitary, single piece  
3 structure.